



## Theory of On-Glass Mobile Antennas

Gary Coffman, KE4ZV

## This is the MMRA...Continued

On-glass antennas are fed at a voltage node by a capacitive coupling made up of the antenna foot, the auto glass, and a small box attached to the inner side of the glass. Now to have the antenna end be a voltage node, the antenna has to be an even multiple of  $1/4$  wave electrically at the frequency of interest. This is usually done with a physical halfwave rod which also has the charm that it doesn't require a groundplane to function properly. Since the auto glass isn't well characterized, and every individual installation is likely to be different, the inner box usually has an adjustment to vary the capacitance for a particular installation. This is usually a "flapper" capacitor bent closer or further from the glass with a nylon cam. The antenna rod is usually slightly longer than a halfwave so it can be shortened by the capacitance to resonance, a series LC circuit.

Now since this is a high impedance point, we'd normally expect the tuning to be quite sharp, but it usually isn't. In trying to find out why not, we discover one of the problem areas of on-glass antennas. That's the usually poor decoupling of the coax shield from the antenna currents. This results in a hot shield, RF in the cabin, and a poor resultant antenna pattern. The reason there is poor decoupling is that the "matchbox" is equipped with a wire and little metal tab that's supposed to "ground" the shield to the auto body. Unfortunately, this doesn't do much good. That's because (1) we're using an

antenna that doesn't work against ground so this isn't a virtual short at VHF/UHF, and (2) because the radio usually isn't well grounded to the body either in today's plastic dash cars so that the return likely is via the power wiring to the battery and then to the body. So we've got a nasty ground loop that includes the coax shield and the window frame. The resultant antenna pattern is unlikely to be omni, unlikely to have it's major lobe in the horizontal plane, and certainly will have less gain than a  $5/8$  wave antenna mounted securely through the center of the top.

The other concern with on-glass antennas is physical. They do tend to fall off or get knocked off more frequently than a through-hole mounted antenna. As an example of both problems, I was using an Avanti on-glass antenna on 2 meters in a Chevy Monza.

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communications. Our network is uniquely capable of providing coverage for any purpose. With about 350 members, the MMRA has significant capability to provide assistance to whoever needs it.

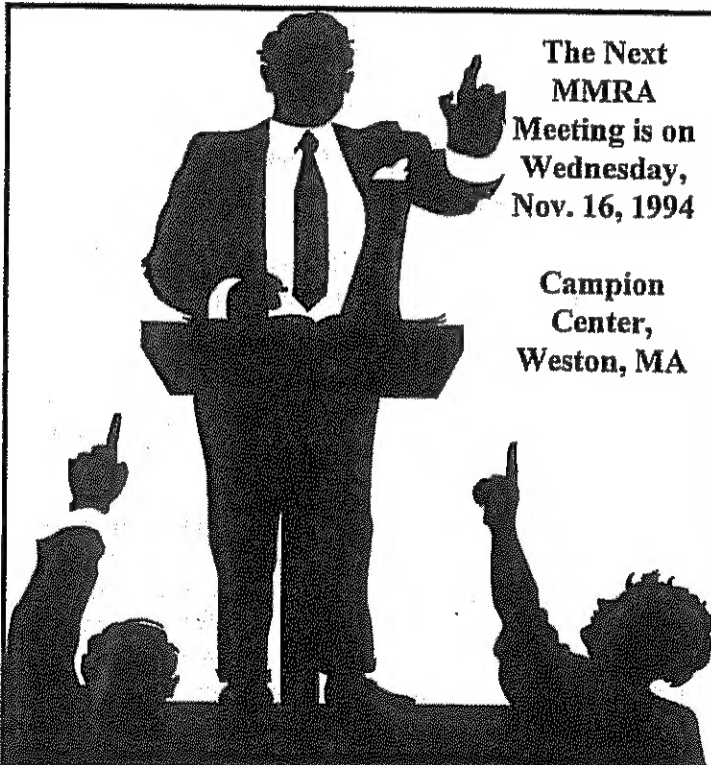
The MMRA has helped in several missing persons searches, hurricanes and blizzards and numerous public service events.

Our system is open to all hams; we hope that frequent users will support the MMRA by joining and getting involved. There's a lot to get involved in....we have an annual flea sale, usually in March. The MMRA sponsors a field day operation sited in

Marlboro on one of the highest hills around, so VHF-UHF operations are effective. We usually have at least 2 HF stations active also.

If you like fox hunting, the MMRA has weekly events. Each Saturday morning at 10:00 AM our fox begins transmitting on the input to one of our 2 meter repeaters, and erstwhile hunters track him down. The hunts usually last about 2 hours, and are informal - designed for fun.

There are membership meetings every other month — the schedule is on the MMRA Information page. There is usually a program; topics have included cell system theory and operation, DFing techniques, antenna theory, repeater systems theory and operation, and a tour of the Weston



Observatory Seismology Lab.

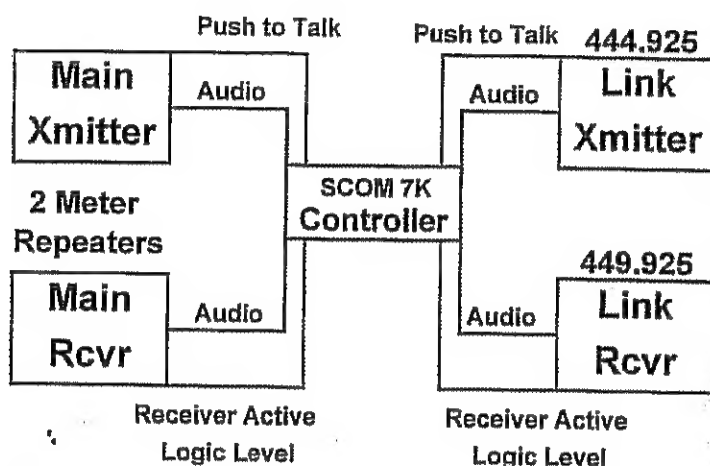
There is a weekly net — The MMRA Technical and Information Net meets Tuesday nights at 2000 hours. We link the repeater system for the duration of the net, and invite all comers to check in. The net serves as a way to get information out to the members between newsletters, and to provide a forum for anyone with a technical question or problem to get good advice from guys who have a lot of experience and knowledge.

So that's a thumbnail sketch of the MMRA....the Association has been around for 24 years, and is an important element in the amateur radio community here in New England. If you have any questions, or are interested in membership information, give our voice mail line a call at 508-489-2282 and a club representative will contact you. Enjoy the convention!

## How the Links Work - A Technical Description

We've gotten a lot of questions about how the linking systems work since installing the SCOM controllers. So here's a description of how each of the linked repeaters and its linking equipment hang together....

### Linking Interconnections



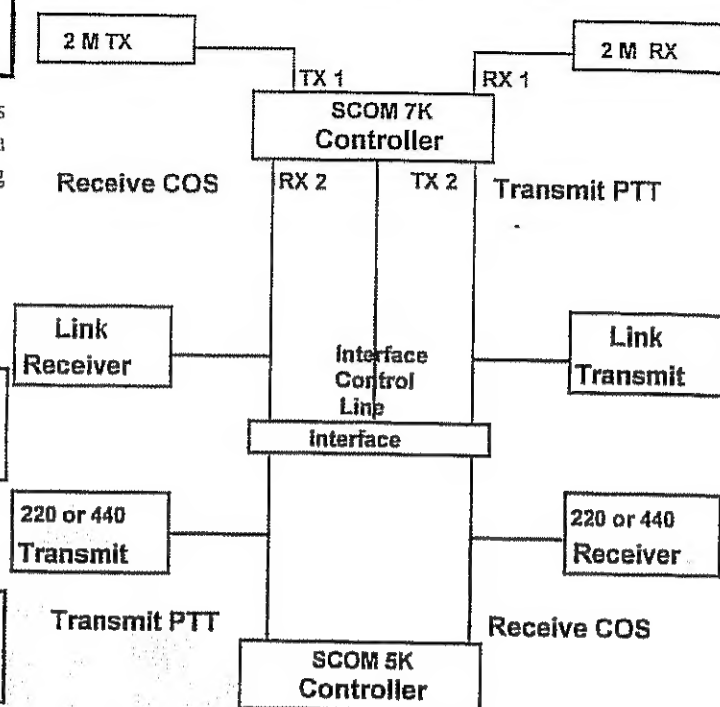
Take a look at the diagram above....in the center is the SCOM controller - the heart of the system. It's fully programmable to assume whatever personality we want; in another article we'll give you a description of how the programming works. But the main component in the controller that allows us to run linked systems is the "multipoint switch" - under program control it can direct any audio source to any audio destination. The controller is designed to control two receivers and two transmitters, and through the multipoint switch can interconnect them so that receive audio on either receiver can be repeated by both transmitters.

All we need to do is to hook up each transmitter's Push To Talk (PTT) and audio inputs to the controller at the contact points designated for Transmitter One and Two. Receiver One and Two audio outputs and Receiver Active Logic Lines (often referred to as COS or COR) are connected to the appropriate contact points.

In programming the controller we instruct it to connect the Receiver One and Two sources to the Transmitters so that when Receiver One is active, both will transmit and repeat the audio from Receiver One. When Receiver Two is active, Transmitter One is repeating and Transmitter Two is down. To control the links we establish commands that enable or disable the paths between the receivers and transmitters. It is even possible to make Receiver One go to Transmitter Two only, and Receiver Two to Transmitter One only.

As described in an earlier article, the link between repeaters is established through the Marlboro 440 machine - as you can see above, Transmitter Two transmits on the Input frequency - 444.925 and Receiver Two listens to 449.925, the output of the

### Multiple Repeater Linking



Marlboro 440 repeater. So, when in a linked state, if Receiver One goes active, both the 2 meter transmitter and the 440 transmitter are on - and Marlboro 440 hears that, repeating whatever is being received by Receiver One.

At another 2 meter site, Receiver Two is listening to the output of Marlboro 440....if it is in a linked state, Receiver Two going active is sensed by the controller, which turns on Transmitter One.

The next diagram shows how we link two repeaters at one site into the system. This is the case at Weston, Stoneham and Quincy. As you can see, this diagram is somewhat more complex....in effect is happening is that the second repeater's controller is cross connected with main controller. The secondary repeater controller TX-PTT is connected to the 7K RX2 (link receiver) COR input. For the sake of simplicity, the diagram uses one line to represent both audio and control lines - so secondary repeater controller transmit audio is summed with the link receiver audio. The summing happens in the interface box shown between the secondary repeater controller lines and the link transmitter and receiver.

The interface box has relays that make or break the control and audio connections between the secondary repeater and the TX2/RX2 contacts on the 7K. When the controller has been given the command that activates the secondary repeater link relays in the interface, this is how it all works....

If you transmit on the input to the main repeater, both TX1 and TX2 (main and link) are turned on. Since the PTT line for TX2 is hooked up to secondary receive COS, the secondary repeater

(Continued on page 4)

## Linking....Continued.

(Continued from page 3)

thinks its receiver is active....and since the audio from link TX2 is coupled in, the secondary controller activates its transmitter, which also repeats what is coming in on the main receiver.

If you transmit on the input of a linked repeater, or on the input of 449.925, link receiver COR goes active. The 7K sees that go high and turns on the main transmitter. Since link receive COR is tied to secondary transmitter PTT, that transmitter turns on and repeats what is coming in on the link receiver. The 5K controller is not involved - the PTT signal is actually the COR signal from the link receiver.

If you transmit on the input of the secondary repeater, its receive COR goes high. The 5K sees receiver activity and turns on the secondary transmitter. Since secondary transmitter PTT is tied in parallel with the link receiver to the 7K RX2 COR input, it turns on both the primary transmitter (TX1) and the link transmitter (TX2).

The main controller, the 7K, can establish the following link states:

- Primary Linked, secondary unlinked
- Secondary linked, primary unlinked
- Both primary and secondary linked
- "Nothing linked.

The commands to do all this will be given to users in September with their 1994-1995 renewal code lists. We are still debugging the program logic involved; there are still a couple of minor bugs. These will be fixed by the end of the summer, and if all goes well, the Stoneham 2 meter and 440 repeaters along with the Quincy 2 meter and 220 repeaters will all be linkable.

So that's how it all works....we'll be giving you some insight into how the SCOM controllers are programmed in a future newsletter. If you have any questions about all this, just check in to the Tuesday night Information Net, or grab one of us at a meeting.

## EASY AS "PI" ATTENUATOR

By Clark Conti, N1NVK

Attenuators help fox hunters to determine the distance to the target by comparing relative signal strength, or the correct beam heading when the signal is too strong to easily determine the peak.

An adjustable attenuator can be worth its weight in gold, unfortunately laboratory types usually are. This article describes one I built with cheap parts (available at Radio Shack) that still does the job.

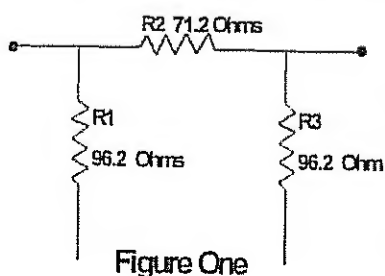


Figure One

The PI attenuator is so named because it physically resembles the Greek letter "PI", two vertical bars connected at the top by a third bar. Although both input and output show equal impedance

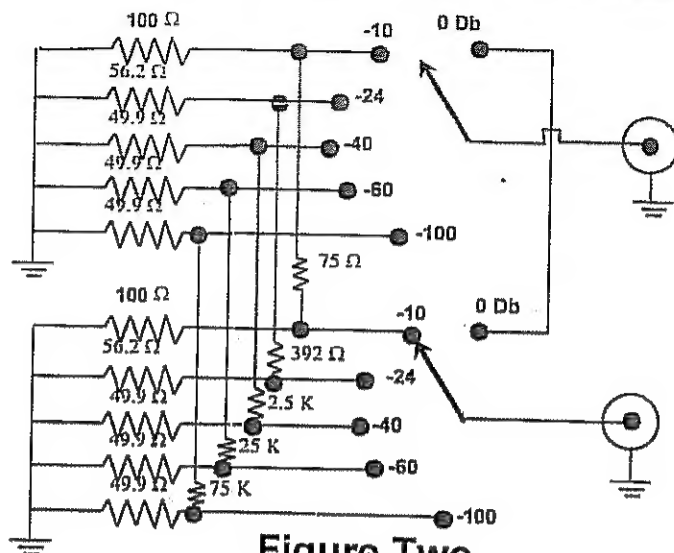


Figure Two

(for our case 50 ohms), part of the signal is reduced as it passes through the device. Figure 1 shows a 10 dB step. Looking at the circuit from either end it appears as a 96.2 ohm resistor in parallel with a 167.4 ohm, or an impedance of 61 ohms... close enough for

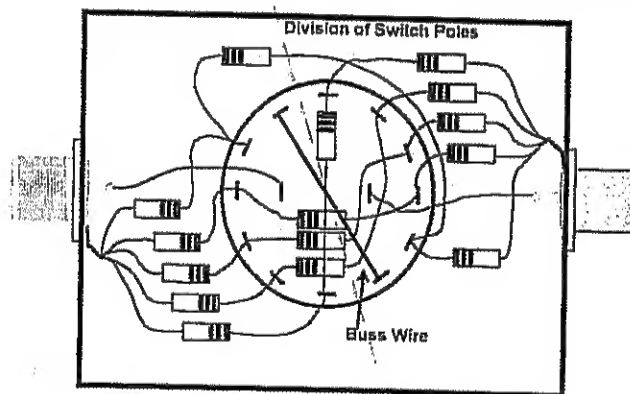


Figure Three - Inside View

us. The signal is reduced by  $R2 / (R2 + R3) = 96.2 / 167.2$  ... OK so that's not exactly 10 dB either, so sue me. The purpose of this project is to build something simple to use for fox hunting, not for a calibration lab.

I combined 5 attenuators on a 2 pole - 6 position rotary switch in a shielded enclosure with 2 BNC connectors so that I could quickly change the signal level coming into my rig. Each successive step knocks a full scale S-Meter reading to about half scale. The last step (or is it the first?) is a straight feed through with no resistors for a direct reading.

The schematic is shown in figure 2 with a parts layout in figure 3. I used 1/4 watt 1% carbon film resistors because I had them, but if I were doing it again I would have chosen 1/2 watt 5% jobs.

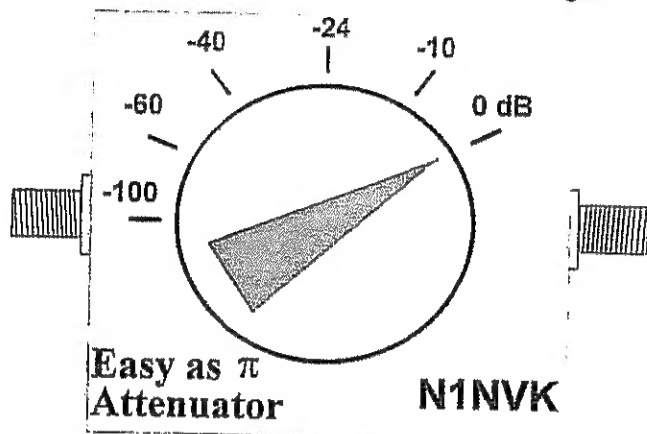
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## Easy as $\pi$ .....Continued.

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They're cheaper and might even survive if you accidentally transmit on low power... I live & learn. Accuracy of the steps stinks, and impedance isn't a perfect match either. Signal on the



100 dB step is only marginally above what leaks into the radio through the speaker grill! BUT I made the whole thing for about 10 bucks and it works, so I call it a huge success. Who needs lab standards anyway? After all, we're not professionals... we're amateurs!

## Not Just for the Old Buzzards....

**Mark Wilkins, AA1IA - Official MMRA Old Buzzard**

Seems to always be that a lot of discussion and numerous articles about all the modes that we amateurs enjoy. Be it SSB, FM, CW, RTTY and the rest. I like them all, but I'd like to rattle your cage about the somewhat forgotten mode of AM, which incidentally is my mode of choice.

I still can't figure out why the mode draws me like a magnet, maybe it has got something to do with fidelity, or maybe it is the infamous 10 or 20 minutes of key downs or could be those wide, wide signals that seem to be the source of of many a SSB's complaint, I JUST DON'T KNOW. (explains the length of this sentence too - ed) Can't say I really know much at all about about a hobby that I haven't been in a year but safely say that I've never met a more friendly (most of the time) helpful and quick-witted (some of the time) bunch of hams since I've been on AM. Must be that eccentric person that seems to be a requirement for all us hams, including the AM'ers.

Guess the reason AM works for me is not just the mystique of it

all but that it has forced me to learn the mysterious inner workings of my rig, which happens to be a remnant of times past. The old YEASU FT 101E. See, the rig sounded like what it was, stock and "yellowish", and it just wouldn't due, so with a little detective work and a lot of questions I tracked down some modifications from up near "SCOWTOWN" someplace north of here and proceeded to RIP the old YAAZZU apart. (Note: all of you "fine biz old man" elmers out there that are snorting a chuckle or two, keep it down, you knew hardly nothing at all about radio once too!!). Just me thinking of tearing into the only HF rig I had is giving me the chills, but there I was, full steam ahead, armed with my trusty fully heated Weller 30 watter and absolutely no idea of what I was doing, it was quite an adrenalin rush to say the least. I managed to screw up pretty good before I got it right, but isn't that what it's all about. I am sure we've all screwed up in the past (ayyyy elmer?). The rig emerged about three weeks later with what I lovingly call "FAT BOY AUDIO". You HARLEY owners know what I'm talkin' bout and since the mod whenever I get an audio check it's usually a good one and that is the stuff that smiles are made of.

One last thing. I'd like to point out that from what I gather, the ranks of AM'ers has been growing steadily for a while. The majority of hams I work with are ten years either way of thirtysomethings, which I am a member of.

Finally, it all seems to me the general feeling among the AM'ers is one of preservation of "Born in the U.S.A.", classic vintage, HeavyIron Rigs. They certainly sound good, but that leaves my old Yeasu 101 out but I guess you've got to roll with what you've got, so I do.

So don't forget to bust out that old 1954 Ranger-one that is sucking up dust in the back of the attic and try AM; again. If you don't, then toss that old boat anchor my way. See you on 3885.

## On Glass Antennas...Continued.

(Continued from page 2)

One night as I was driving down the interstate the rod fell off. I didn't notice, and the fellows with whom I was talking didn't notice. That's because the coax in the cabin continued to be the primary radiator. Note that the dashboard tach always noticed when I was transmitting by jumping to 6000 RPM any time I keyed down, whether the rod was in place or not.

As usual, your mileage may vary, but I'm not going to bother with on-glass ham antennas anymore. I either drill the hole, or use a magmount expedient.

*Next Year is the Twenty-Fifth Anniversary of the MMRA!*

# MMRA Information - Repeaters, Officers and Board Members

## MMRA Repeaters:

Marlboro	146.61	N1BHI/R	FTL	P	
Marlboro	449.925	N1HBR/R	FTL	P	
Quincy	146.67	KA1HKP/R	PTL	P	
Quincy	224.40	N1KUG/R	FTL	L	PL - 103.5 in, none out
Weston	146.82	KA1AL/R	PTL	P	
Weston	224.70	N1HBR/R	FTL	L	
Hopkinton	223.94	N1BHI/R	FTL	L	
Stoneham	146.715	N1NVL/R	PTL	P	PL - 146.2 out, none in.
Stoneham	446.725	N1NVK/R	PTL	L	PL - 88.5 in, none out

[FTL = Full Time Linked      PTL = Part Time Linked]

[L = Patch available via link]      P = Local Autopatch]

## MMRA Officers:

President:	Andy Morrison, N1BHI
Vice President:	Walter Ching, N1HBR
Secretary:	Frank Morrison, KB1FZ
Treasurer:	Ian MacLennan, AF1R
Clerk:	Clark Conti, N1NVK
Directors:	Tom Qualtieri, WB1GMA

To Contact Officers  
or Board Members  
Call MMRA Voice  
Mail Line:

508 - 489 - 2282  
Toll Free from  
508 and 617 Areas

Newsletter Editor:

Associate Editor

Andy Morrison, N1BHI  
Walter Ching, N1HBR

## Important MMRA Club Information:

### Membership Meetings:

3rd Wed of Sep., Nov., Jan., Mar, May at Campion Center, Weston at 7:30 PM  
Meeting Dates for 1994-95 Season: September 21, November 16, January 18, March 15, & May 17.

### Board Meetings:

3rd Wed of Oct., Dec, Feb., Apr. Meetings are open and members are welcome.  
If a visiting member wants to be on the agenda, please contact Andy Morrison beforehand.  
(508) 489-2282. — This is a local call to any 508 exchange phone.

### MMRA Voice Mailbox

### Newsletter Information

### Mailing Date

### Submission Deadline

<u>September issue</u>	<u>November issue</u>	<u>January issue</u>	<u>March issue</u>	<u>May issue</u>
Sept 14, 1994	Nov. 9, 1994	Jan. 11, 1994	Mar 8, 1994	May 10, 1994
Sept 10, 1994	Oct. 26, 1994	Dec 28, 1994	Feb. 22, 1994	Apr. 26, 1994

The MMRA is dedicated to Amateur Radio and the public service. The MMRA is a registered non-profit Massachusetts corporation. Membership is open to all amateurs. Annual dues are \$25.00 individual, \$35.00 family.



SOME OF THE MMRA FIELD DAY CREW...N1BHI,  
WB1GMA, N1BHA, WA1ZJE, N1NVK, W1JDO.  
W1JDO PHOTO.

**If you have enjoyed reading this special issue, and live or travel through our coverage area, give some thought to becoming a Minuteman Repeater Association member. Try our repeaters and meet some of the people who hang out on them during the commute hours, days and evenings. Check out our Tuesday night nets...and if you like what you hear, join us. And don't forget that all our 2 meter machines have autopatches, and linked machines access the patch on 449.925. You won't find a better repeater club deal in New England!**